Information Sheet - Trip Hazards

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Summary

Trip occurs when the surface that is being walked upon has an abrupt increase in height that is large enough to snag the toe of a shoe and cause the walker to loose balance. Except as part of a properly constructed stair, the maximum acceptable abrupt change in height for an area constructed for pedestrian use is 6mm.

Human Gait

Information on human gait is provided on a separate information sheet[1] that describes the various phases and events of gait. In respect to trip, the principal relationship is the movement of the foot in the vicinity of a rise in ground level. If the rise is greater than the clearance between the preceding ground level and the foot then contact will be made. Unsuspected contact of this type is likely to result in a trip which then causes a fall.

The study[2] of human gait shows that the toe is generally the lowest part of the swinging foot. However, just before 'initial contact' the foot pivots so that the heel touches first. The toe is the last part of the foot to lift off at the start of the swing and the heel is first to make contact at the end of the swing. Hence during trip it is most often the toe that makes contact with the change of height.

Trip Hazards

Gait analysis indicates that the clearance between toe and ground during the 'swing phase' is small. This relates to persons walking on an even surface, where the expectation is to place each foot on a surface of the same level as the previous step. Such a condition exists in buildings, on paved footpaths and other sealed surfaces, as often found in urban areas.

A study by Murray[3] found toe to ground clearance in the range on 1 - 38mm with a mean of 14mm. Based on this data, a rise in height of 14mm would represent a trip hazard to 50% (half) of the people tested. It is estimated that 10% of those tested would also trip if the rise was 6mm. That is, 90% would not find it a trip hazard. This is considered to be an acceptable clearance rate and accordingly 6mm is considered to be a threshold level for consideration of trip hazard for a pedestrian.

The measurement of 6mm (¼ inch) is consistent with our experience in investigating pedestrian accidents and accident sites. It is also consistent with other published materials such as Brown & Obenski[4], English[5], Statewide Mutual[6] and VOSI[7].

(continued over)

[1] Information Sheet - Human Gait, Andrew & Alan Brown, Civil & Forensic Pty Ltd - www.cnf.com.au
[2] "Gait Analysis- an introduction" Second Edition, MW Whittle, Butterworth-Heinemann, 1996
[3] "Gait as a total pattern of movement", MP Murray, American Journal of Physical Medicine v46 pp290-333, 1967
[4] "Forensic Engineering Reconstruction of Accidents", Brown & Obenski, Charles C Thomas Publisher - 1989
[5] "Slips, Trips and Falls", William English , Harrow Press, 1989
[6] "Best Practice Manual - Footpaths, Nature Strips and Medians", Statewide Mutual - www.statewide.nsw.gov.au
[7] "Slip & Trip Resistant Sidewalks and Swimming Pool Decks", V41.23E, VOSI, 2001

Statewide Mutual is a self insurance mutual of NSW Local Government Authorities. Their best practice manual for footpaths deals with trip hazards. It identifies trip sizes (abrupt change in height) of less than 5mm as being a low risk hazard; trip sizes of 5 - 10mm as being a medium risk hazard; and so on.

VOSI is American private sector standards organisation that specialises in public safety standards. It's standard guide states that the "*Maximum vertical mismatch of adjacent sidewalk panels, or utility access covers within walkways, is 1/4"* [6mm] *maximum without edge treatment."*

It is also noted that electrical cords are often cited in workplace safety manuals as a potential trip hazard if placed across passageways or other areas pedestrian where pedestrians travel. Common office or domestic power cords (including extension cords) are commonly 6 to 7mm in diameter. The consideration of these cords as a trip hazard is consistent with a maximum acceptable change in height of 6mm.

Steps and Stairs

Properly constructed stairs have a rise at each step of greater than 6mm. However, all steps are not trip hazards. The purpose of steps are to allow pedestrian access between two surfaces that are at different levels. The greater the difference in level, the more steps are required to 'join' the levels. In some cases, where the difference in height is low enough, there may only be a single step between the surfaces.

The distinction as to whether a step is a trip hazard or not relates to the likelihood that a pedestrian would perceive it to be a step. That is, if the step is not visually conspicuous to pedestrians then it is likely to be a trip hazard regardless of the height of the step.

Building regulations and standards such as the Building Code of Australia and Australian Standard AS 1657 specify dimensional requirements for stairs. The minimum step height allowable is 115mm (BCA). Such steps are usually visually conspicuous because of their size.

The following are some of the factors that make steps a trip hazard:

- ❑ isolated low single step or a single step in a heavily trafficked area;
- ❑ steps in areas where there are visual or other distractions (eg. retail displays);
- ❑ variable height step, such as a tapered step;
- ❑ variation in the size of steps, particularly in the height of steps in a stair;
- ❑ finish or covering that allows steps to blend with surroundings.

In the case of properly constructed steps or stairs, the change of height associated with a step would be conspicuous to pedestrians. Accordingly, a properly constructed stair would not pose a trip hazard.

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